

12. A Proposed Pattern of Enterprise Architecture

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Abstract

The latest versions of the Department of Defence and Ministry of Defence Architecture Frameworks (DoDAF and MoDAF), as well as the Object Management Group's Unified Profile for DoDAF and MoDAF each employ a meta-model, thus providing a basis for effective implementation of tools for constructing consistent architecture descriptions.

UPDM comprises extensions to both OMG's Unified Modelling Language (UML) and Systems Modelling Language (SysML), and thus provides for architectural descriptions that contain a rich set of (formally) connected DoDAF/MoDAF viewpoints expressed in a form familiar to those who use UML and SysML.

These represent significant advancements that enable architecture trade-off analyses, architecture model execution, requirements traceability, and speedier transition to systems design and implementation. All very useful to both the enterprise architect and the solutions architect. But is there more that can be done, especially for those who should contribute input to the enterprise architecture?

In this paper an extra model/view in the form of a pattern is described that is intended to aid in the development of enterprise architectures (EA), both small and large. The proposed pattern of EA is developed using information extracted from the Computer Emergency Response Team Resilience Maturity Model (CERT RMM) and the Capability Maturity Model Integrated (CMMI) for Acquisition, and for Services as well as the People Maturity Model.

Although not completed, the pattern of EA is developed to the extent that some benefits from its use/application across several types of organisation are readily apparent. One of its main benefits is to allow business analysts/engineers early capture of EA requirements. A further benefit is that the 'pattern' should be easier for executive decision makers to appreciate and understand – without feeling technically incompetent.

Presenter Biography

As a professional, **Dr Clive Boughton** possesses over thirty years of practical experience in varying roles as scientist, engineer, software engineer, consultant, and project and company manager. His collective experiences have given him the opportunity to observe/research/manage and participate in commercial, defence and scientific software projects including native and embedded applications using contemporary techniques, languages and management methods.

Clive held a full time academic position at ANU from 2000 – 2010 during which time he developed the final touches to the (then) new Bachelor of Software Engineering. He also fully developed the Masters in Software Engineering, the major parts of which still exist in the MCOMP program. Clive is an adjunct associate professor at both the ANU and UQ.

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14. ABSTRACT The latest versions of the Department of Defence and Ministry of Defence Architecture Frameworks (DoDAF and MoDAF), as well as the Object Management Group's Unified Profile for DoDAF and MoDAF each employ a meta-model, thus providing a basis for effective implementation of tools for constructing consistent architecture descriptions. UPDM comprises extensions to both OMG's Unified Modelling Language (UML) and Systems Modelling Language (SysML), and thus provides for architectural descriptions that contain a rich set of (formally) connected DoDAF/MoDAF viewpoints expressed in a form familiar to those who use UML and SysML.						
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He now spends most of his time undertaking all sorts of systems/software engineering consulting and project management work through Software Improvements, a company he set up in 1992.

Qualifications:

- BSc (Applied Physics) - RMIT - 1976,
- PhD (The Total Differential Scattering Cross Sections of some Weakly Anisotropic Molecules) - ANU - 1988.

Affiliations:

- Member ACM, Member IEEE Computer Society, Member ACS
- Chair of Australian Safety Critical Systems Association (aSCSa)

Main Research and Industry Interests

- Requirements Engineering
- Project Management
- Modelling Languages and Techniques
- Model-driven Development
- Software/Enterprise Architecture
- Software Measurement

Present Appointment

Technical Director and Chair of Board at Software Improvements Pty Ltd

Presentation



Software Improvements

MBSE
SYMPOSIUM 2012

A Proposed Pattern of Enterprise Architecture

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Context

NOTHING HERE IS NEW!

Just throwing in some ideas & concepts!

Maybe some light bulb moments for you?

Not quite finished yet!







No! I'm not on drugs!

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What prompted my thinking?

Severally: Architecture, Processes, Decisions

- **Interesting experiences and/or observations**
 - Especially decisions and processes lacking 'logic'
- **Seeing people reel from too much (mindless) change**
 - As well as information overflow
- **Seeing repercussions of many COTS 'solutions'**
 - A COTS gives us 80% of the solution!! A silver bullet?!
 - Little / no analysis of options – a 'shaped' OCD
- **Continuing, awkward integrations of business & IT**
 - Even though 'architecture' has been around for a while
 - Despite the recognised imperative of up-to-date information
- **Perhaps because I am confused**
 - After all everything is getting more complex – isn't it?
 - Cost, time and quality still matter – don't they?

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What prompted my thinking?

Stuff that's not being referred to or used often

- **Architecture Frameworks – in last 5 years**
 - DoDAF, MoDAF, latest versions are more holistic wrt EA
 - UPDM becoming very mature and supports MBSE well!
 - TOGAF seems to have significant following - doesn't seem to support MBSE.
- **CMMI in last 10 years (from SEI & CERT)**
 - **Development**
 - Covers systems & software – roots from SW-CMM 1991
 - **Services**
 - Greater than 80% of world economy
 - Greater than 50% US DoD acquisitions.
 - **Acquisition**
 - Most enterprises do this – began 1994
 - **Resilience**
 - Extends Services to include greater emphasis on business survival
 - **People**
 - For developing individual capability to shaping the workforce



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Observations - 1

‘Business’ Organisations

- **Most deemed to be *governed* by ‘business strategy’**
 - Strategic directions – driven by ‘environment’ (*change*).
 - Business needs – driven by ‘market’ (*change*).
 - Operational needs – driven by ‘technology’ (*change*).
 - Efficiency needs – driven by ‘economy’ (*change*).
- **Most interventions cause significant and costly disruption**
 - **Few interventions are successful – particularly large ones**
 - Don't live up to expectations or ‘improve things’
 - Risk! What's that? We'll be right mate!
 - Take years to facilitate and get into shape
 - Leave a big ‘?’ regarding value for money
 - Leave mostly LOSERS



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Observations - 2

‘Business’ Organisation Architectures

- **Enterprise Architecture:**
 - Mostly immature – or do not really exist
 - Typically ‘controlled’ by IT infrastructure
 - Infected with legacy constraints
 - Minimally documented – if they do exist
 - Rarely articulated as being associated with ‘business’
 -
- **Systems Architecture:**
 - Usually seen as only the IT stuff
 - Sometimes seen as the EA (*because of multiple SAs*)
 - Sometimes appears completely separate to EA
 -

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Observations - 3

‘Business’ Organisation Maturity Essentials

- **Business**
 - Structure
 - Nature
 - Stability
- **Management**
 - Style
- **Capability**
 - Consistency
 - Professional depth
- **Resiliency**
 - ‘Ready’ for impacts of change
 - Survivability

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Overview of inputs

Organisations and their business

- Do they know what they do?
- Do they know their business drivers (and changers)?
- Are they struggling with the IT behemoth?

Enterprise architecture


- Is it all determined from OV-1?
- Is it overborne by IT constraints?
- A holistic view or a bitsy view (system-by-system)?

Architectural frameworks

- DoDAF emphasis now on data-centric process!
- DoDAF in context with FEA and OMB's EAAF!

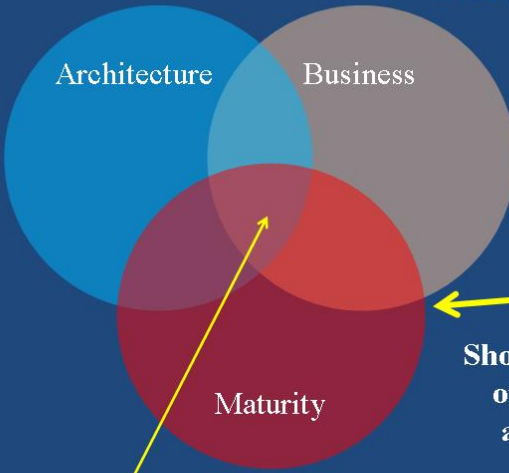
FEA = Federal EA, OMB = Office of Management & Budget, EAAF = EA Assessment Framework

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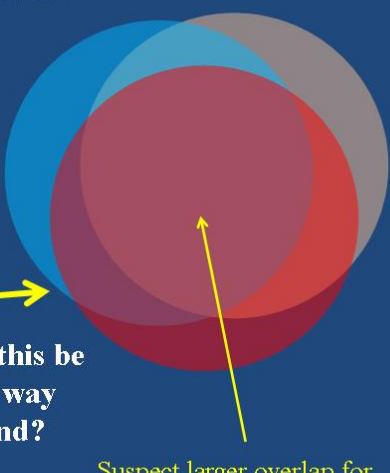


Optimal B-A-M overlap?

Does it matter?



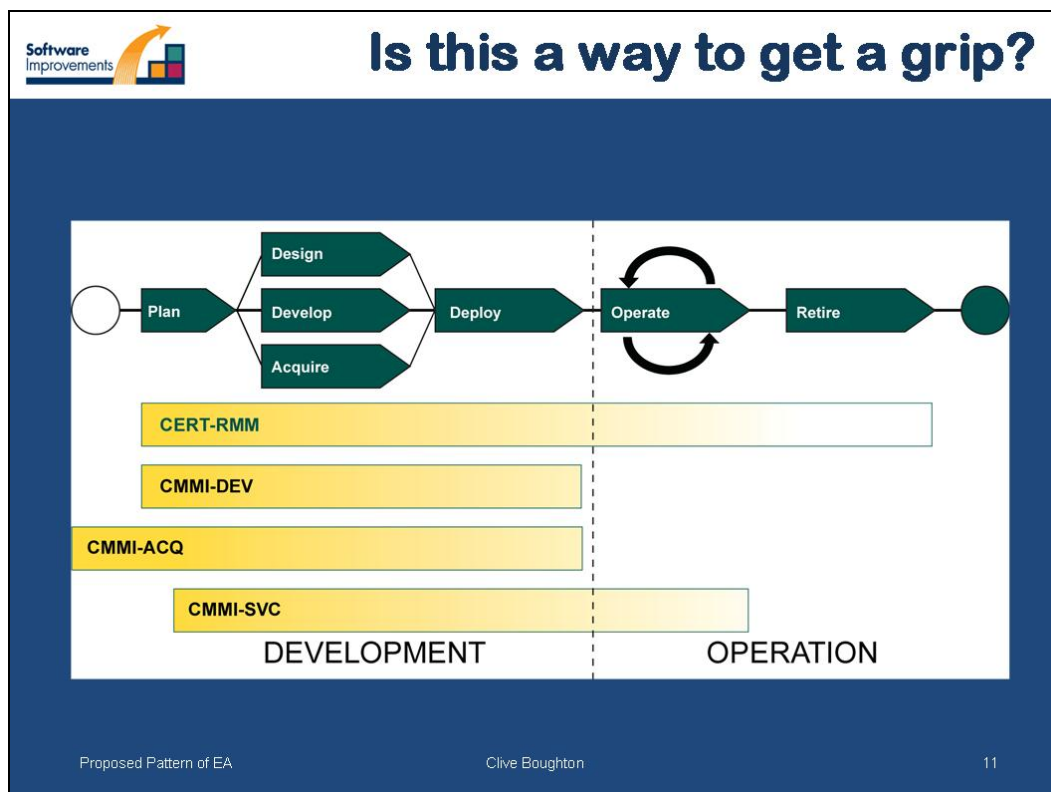
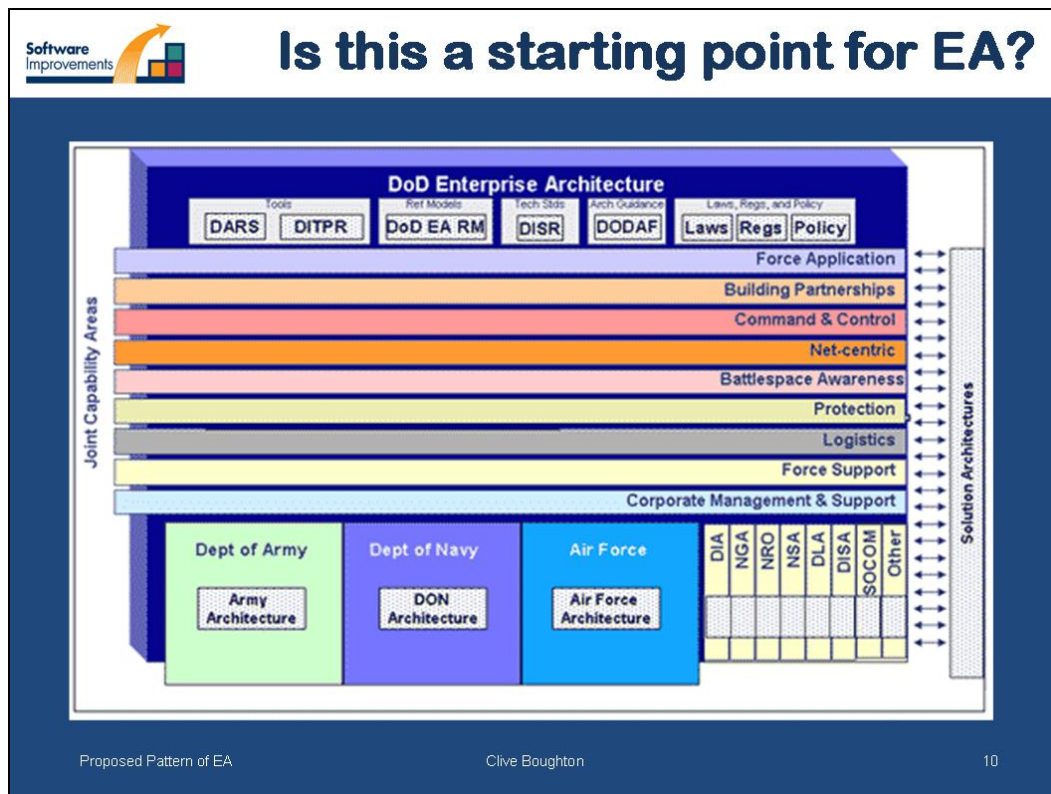
Probably only small overlap for orgs. subject to continuous change.



Suspect larger overlap for orgs. subject to low levels of change.

Should this be other way around?

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Software Improvements

Answer: To last 2 questions

Perhaps!

BUT Conceptualisation is key!

OooKay!
So, let me see
what you cook
up!



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Software Improvements

Perceptions!

CONCEPTUALISATION!?

Anyway! I'm no geek.
So, do I need to know?




Is that an ORG-CHART?

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Properties

If thinking about systems and their conceptualisation it's appropriate to study some basic properties!

DATA	PROCESS	STATE
PROCESS	STATE	DATA
STATE	DATA	PROCESS

Treat a business organisation as a complex real-time system

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Clues: CERT-RMM & CMMI-Svc

Services

- Form a layer, decoupling Operational activities from organizational arrangements of resources, such as people and information systems.
- Form a pool that can be orchestrated in support of operational activities, and the Operational activities define the level of quality at which the Services are offered.

Capabilities

- Relate to Services via the realization of the Capability by a Performer that is a Service.
- In general, a Service would not provide the Desired Effect(s), but rather, [provide] access to ways and means (*activities & resources*) that would.

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Clues: CERT-RMM & CMMI-Svc


Operations

- Realise Capabilities.

Systems

- Help fulfill Capability requirements.
- Support Operational activities & facilitate information exchange.

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Clues: CERT-RMM Proc. Areas

Engineering	Enterprise Management	Operations	Process Management
ADM	COMM	AM	MA
CTRL	COMP	EC	MON
RRD	EF	EXD	OPD
RRM	FRM	ID	OPF
RTSE	HRM	IMC	
SC	OTA	KIM	
	RISK	PM	
		TM	
		VAR	

Lots of processes but NO DATA MODEL!

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Clues: Conceptual Data Model

DIV-1 (new in DoDAF 2.0):

- Addresses the information concepts at a high-level on an *operational architecture*.
- Used to document the business information requirements and structural business process rules of the *architecture*.
- Describes information that is associated with the information of the *architecture*. Includes information items, their attributes, and their inter-relationships.

The intended usage of the DIV-1 includes:

- Information requirements
- Information hierarchy

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Clues: Logical Data Model


DIV-2:

- Allows analysis of an *architecture's* data definition aspect, independent of implementation / product specific issues.
- Provides a common data definition dictionary to consistently express model descriptions including -
 - ▶ Information in an OV-1 High Level Operational Concept Model or an Activity Resource flow object in an OV-5b Operational Activity Model.
 - ▶ Entities & elements constrained and validated by capture of business requirements in an OV-6a Operational Rules Model.
 - ▶ Information content of messages that connect life-lines in an OV-6c Event-Trace Description.
 - ▶ Elements required due to Standards in the StdV-1 Standards Profile or StdV-2 Standards Forecast.

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Clues: Logical Data Model

DIV-2:

- Bridges the gap between the conceptual data model and physical-levels.
- Introduces attributes and structural rules that form the data structure.
- Provides more detail than the conceptual data model.
- Communicates more to the architects and systems analysts types of stakeholders.

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DoDAF Meta-Model Definitions

Activity: Work, not specific to a single organization, weapon system or individual that transforms inputs (Resources) into outputs (Resources) or changes their state.

Resource: Data, Information, Performers, Materiel, or Personnel Types that are produced or consumed.

- Materiel:** Equipment, apparatus or supplies that are of interest, without distinction as to its application for administrative or combat purposes.
- Information:** The state of a something of interest that is materialized - *in any medium or form* - and communicated or received.
 - ▶ **Data:** *Representation of information in a formalized manner suitable for communication, interpretation, or processing by humans or by automatic means. Examples could be whole models, packages, entities, attributes, classes, domain values, enumeration values, records, tables, rows, columns, and fields.*
 - ▶ **Architectural Description:** *Information describing an architecture such as an OV-5b Operational Activity Model.*

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DoDAF Meta-Model Definitions

- **Performer:** Any entity - human, automated, or any aggregation of human and/or automated - that performs an activity and provides a capability.
 - ▶ **Organization:** A specific real-world assemblage of people and other resources organized for an on-going purpose.
 - ▶ **System:** A functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements.
 - ▶ **Person Type:** A category of persons defined by the role or roles they share that are relevant to an architecture.
 - ▶ **Service:** A mechanism to enable access to a set of one or more capabilities, where the access is provided using a prescribed interface and is exercised consistent with constraints and policies as specified by the service description. The mechanism is a Performer. The capabilities accessed are Resources - Information, Data, Materiel, Performers, and Geo-political Extents.

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DoDAF Meta-Model Definitions

Capability: The ability to achieve a Desired Effect under specified (performance) standards and conditions through combinations of ways and means (activities and resources) to perform a set of activities.

Condition: The state of an environment or situation in which a Performer performs.

Desired Effect: A desired state of a Resource.

Measure: The magnitude of some attribute of an individual.


Measure Type: A category of Measures.

Location: A point or extent in space that may be referred to physically or logically.

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DoDAF Meta-Model Definitions

Guidance: An authoritative statement intended to lead or steer the execution of actions.

- **Rule:** A principle or condition that governs behavior; a prescribed guide for conduct or action.
 - ▶ **Agreement:** *A consent among parties regarding the terms and conditions of activities that said parties participate in.*
 - ▶ **Standard:** *A formal agreement documenting generally accepted specifications or criteria for products, processes, procedures, policies, systems, and/or personnel.*

Project: A temporary endeavor undertaken to create Resources or Desired Effects.

Vision: An end that describes the future state of the enterprise, without regard to how it is to be achieved; a mental image of what the future will or could be like.

Skill: The ability, coming from one's knowledge, practice, aptitude, etc., to do something well.

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Basic Properties - 1

‘Business’ Organisations

- **Usually driven by desired goals & have a mission**
- **Usually comprise:**
 - ▶ Financial ‘systems’
 - ▶ Human resource ‘systems’
 - ▶ Assets (property, equipment, people)
 - ▶ Administrative ‘systems’
- **Typically provide:**
 - ▶ Services (and their maintenance)
 - ▶ Products (and their maintenance)
- **Sometimes undertake:**
 - ▶ Acquisitions
 - ▶ Developments

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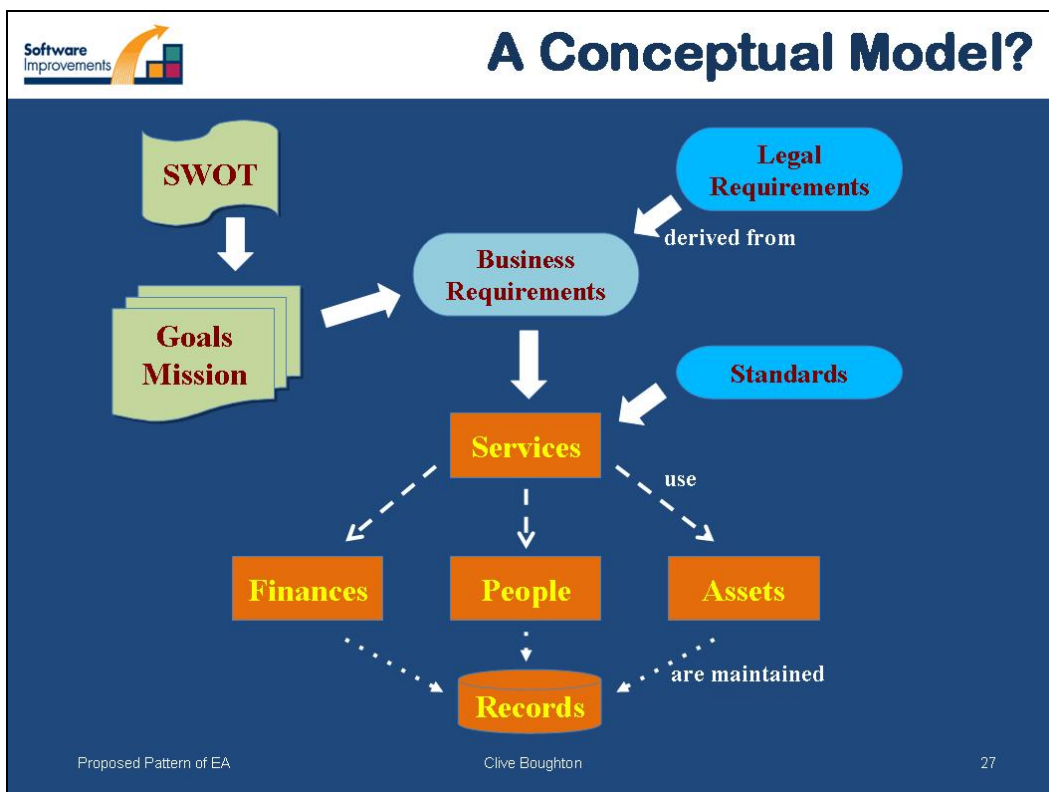


Basic Properties - 2

‘Business’ Organisations

- Typically see assets as:
 - Buildings
 - Vehicles
 - Furniture
 - Computing equipment
 -
- Often DON'T see assets as:
 - People
 - Information
 - client information maybe an exception
 -

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Potential issues

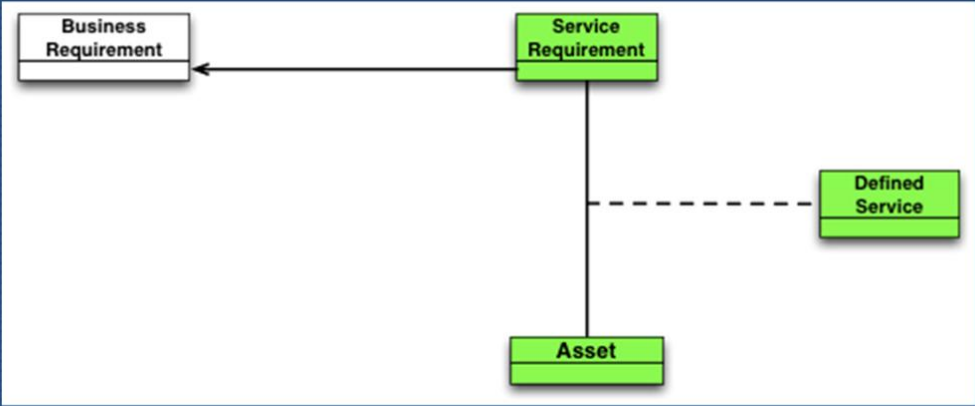
Lots can go wrong

- **SWOT**
 - Too many Ws & Ts
- **Forgot the mission**
 - Didn't pass grandmother test (Don Watson – Weasel Words)
- **New legal requirements**
 - Requiring significant changes to services / products
- **New standards**
- **Poor service delivery**
- **Bad financial management**
- **Ageing assets**
- **A workforce growing more 'inflexible'**

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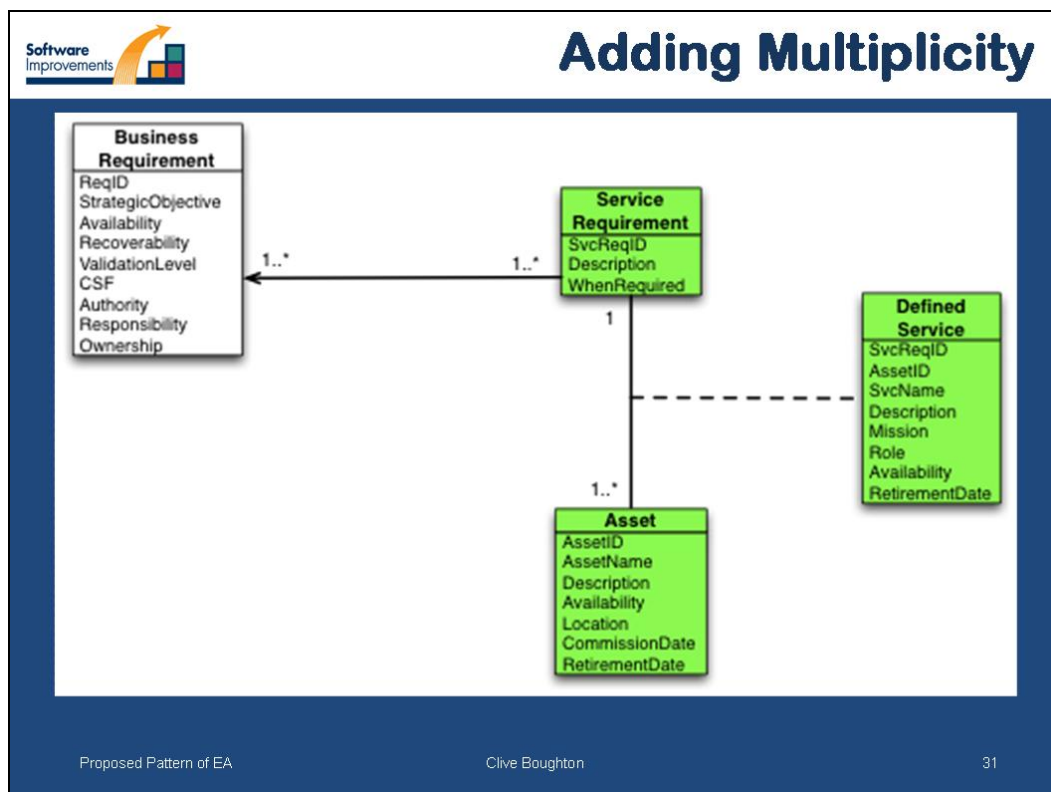
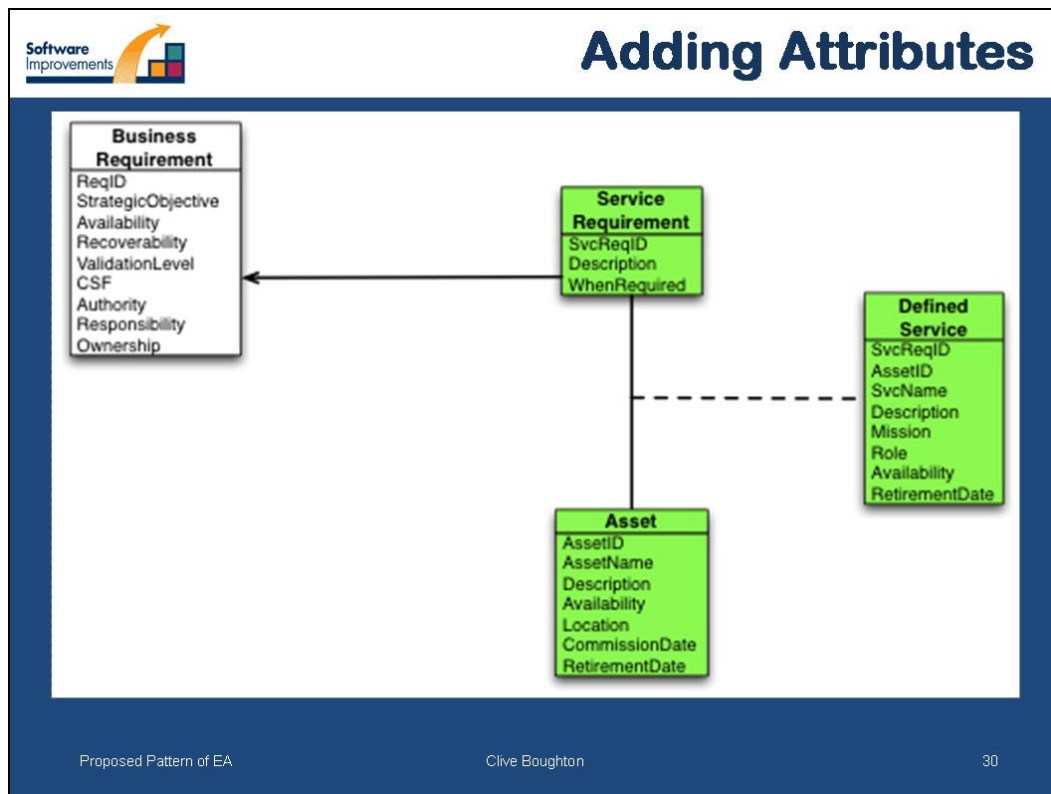


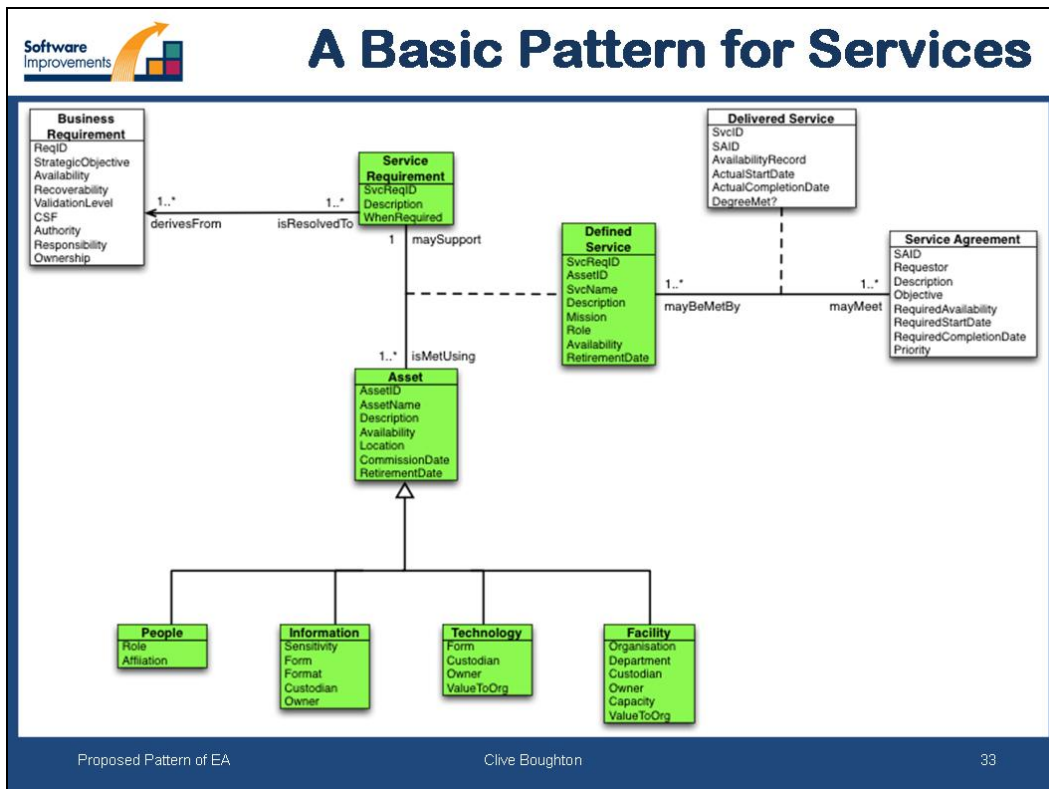
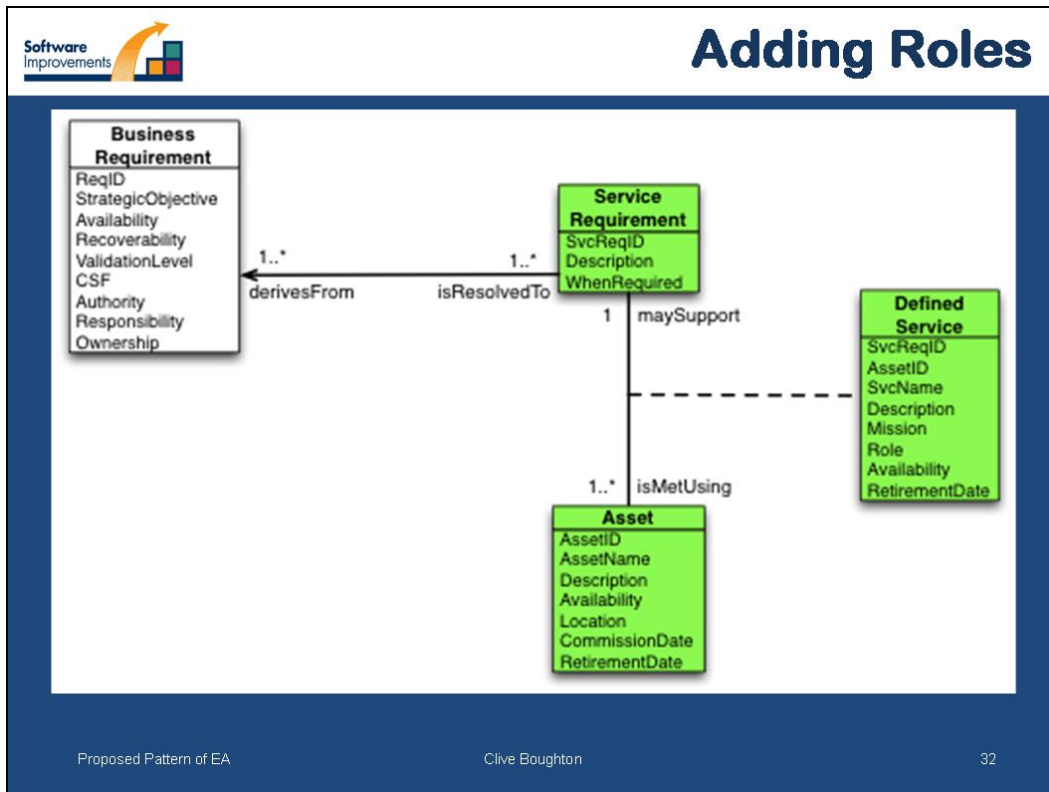
The Basic Concept Model

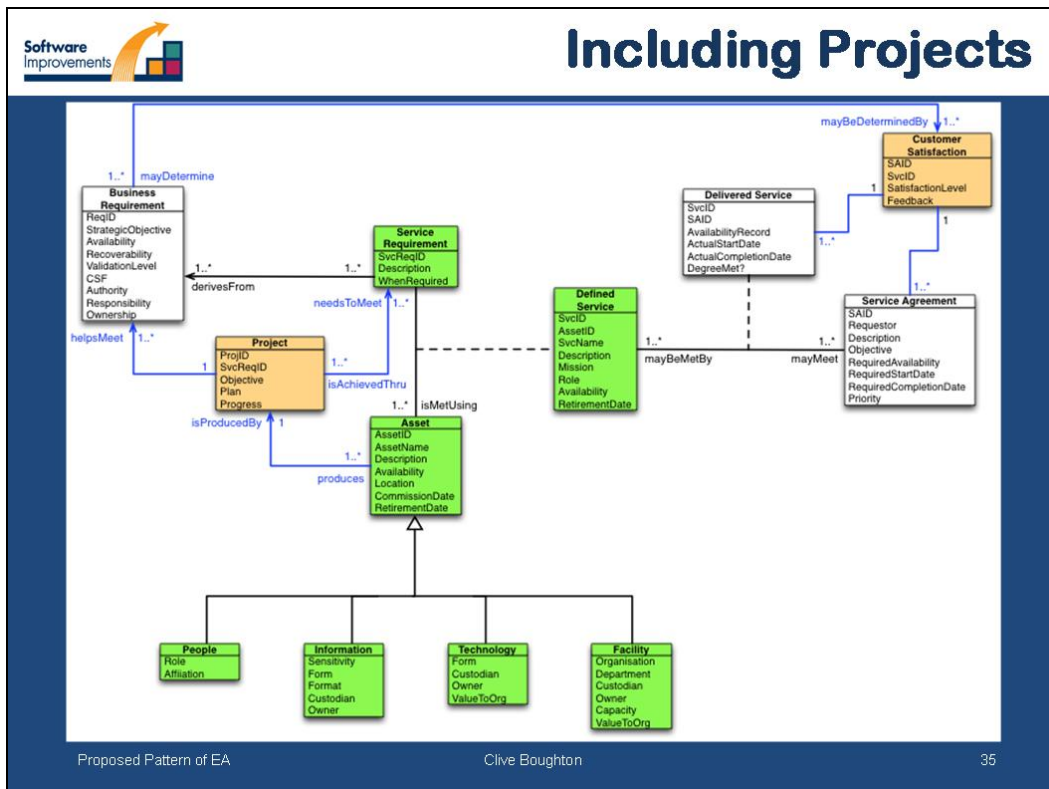
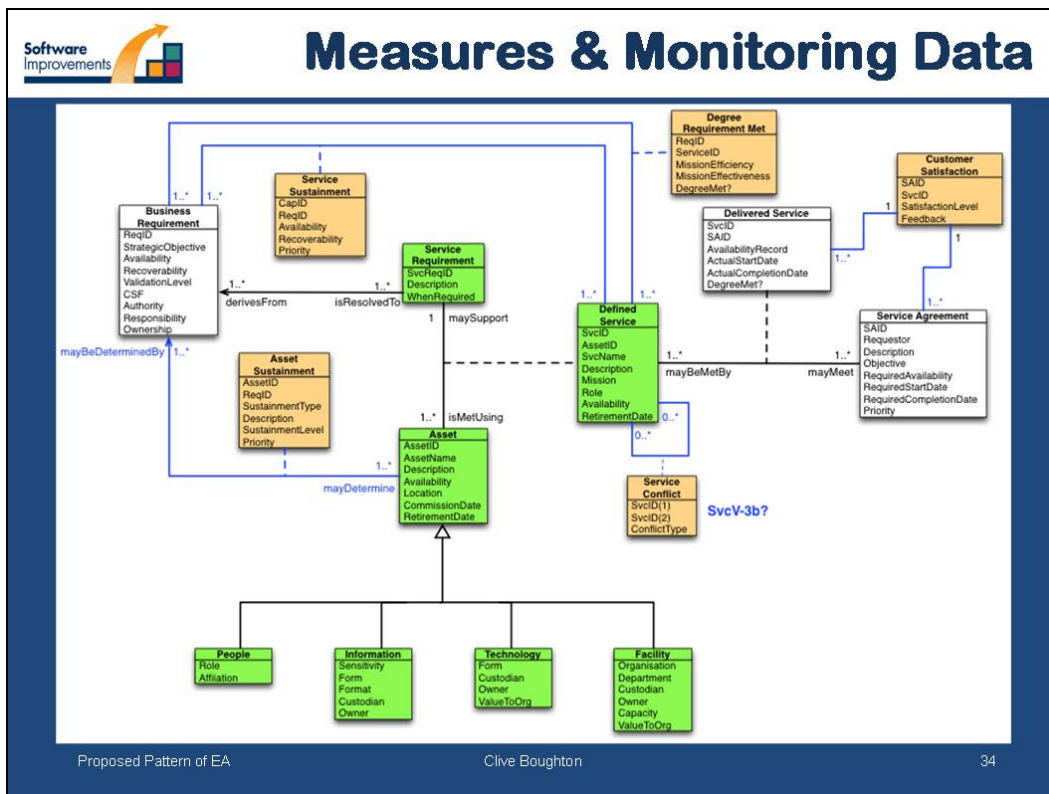


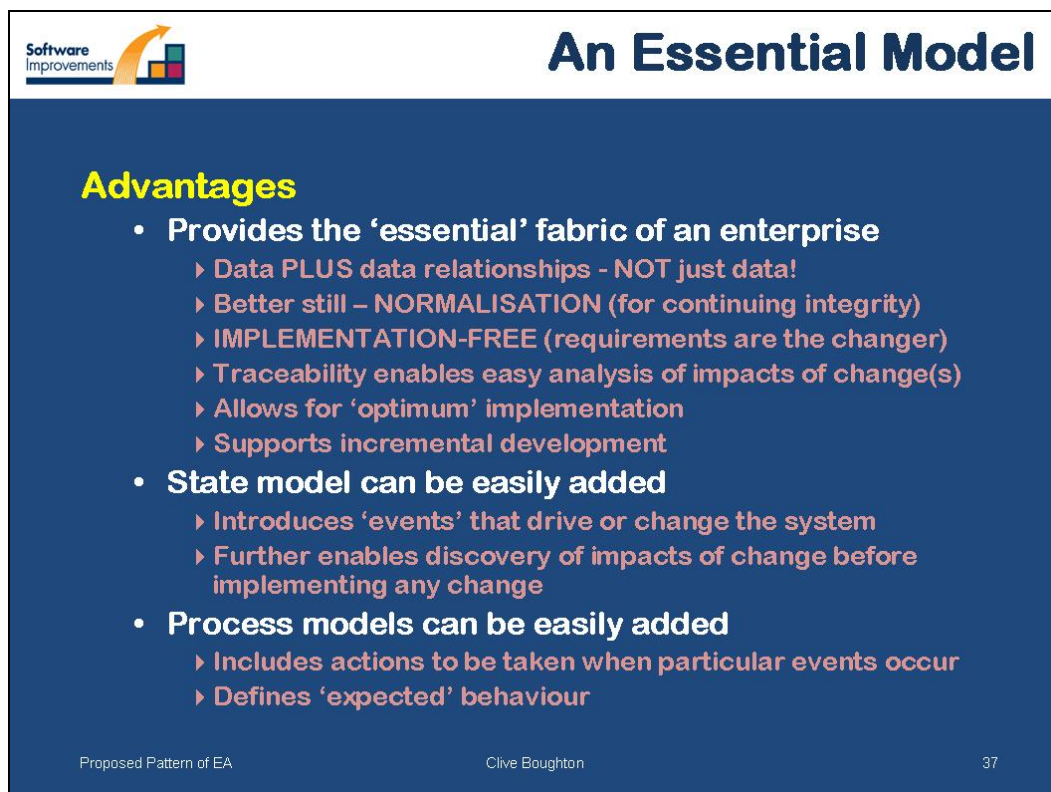
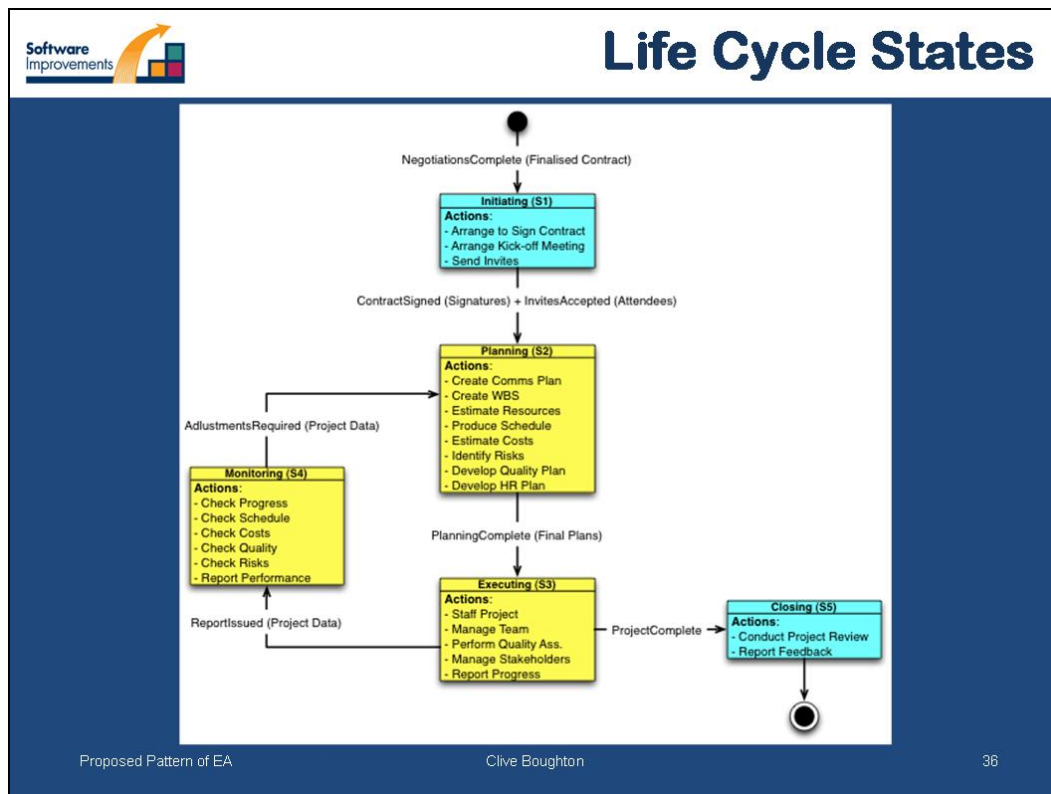
```
graph TD; SR[Service Requirement] --> BR[Business Requirement]; SR --- AS[Asset]; SR -.- DS[Defined Service]
```

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Information Model

Advantages

- Can obtain a comprehensive (logical) model:
 - Of essential enterprise requirements – which can be used to build and / or evaluate any particular enterprise
 - Of architectural and design building blocks that are free from any (vendor) implementation
 - Based on other mature models concerning enterprises (e.g., CERT-RMM, CMMI-Svc)
 - That can be 'mapped' to existing enterprise when it's difficult to comprehend what to do when undertaking 'changes'
 - That enables more effective and more timely enterprise process improvement
 - Useful for simulation and automated development – NIRVANA (for some)!
- Strongly supports MBSE!!

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Usefulness of Model


To Executives

- Only a few concepts and representations to learn and remember – and they can be kept simple!
- Not limited to OV-1 (*I think this is good!*)
- Aligns better with basic visualisations of what a business organisation does.
- Enables simplified views – for different levels of understanding
- Discussions can remain conceptual in nature – there's no technology but an executive has a greater opportunity to understand whether an implementation technology has been successful or not.

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Usefulness of Model


To Architects

- Less translation is required before discussions with executives.
- Provides a common point of understanding.
- Traceability to requirements enables impacts of changes to be discovered and described more easily.
- Can use model to more quickly undertake architectural and design tradeoffs - AADL and more advanced modeling tools will be very useful here.
- Can use model to effect simulation – again AADL and the more advanced modeling tools may be very useful.

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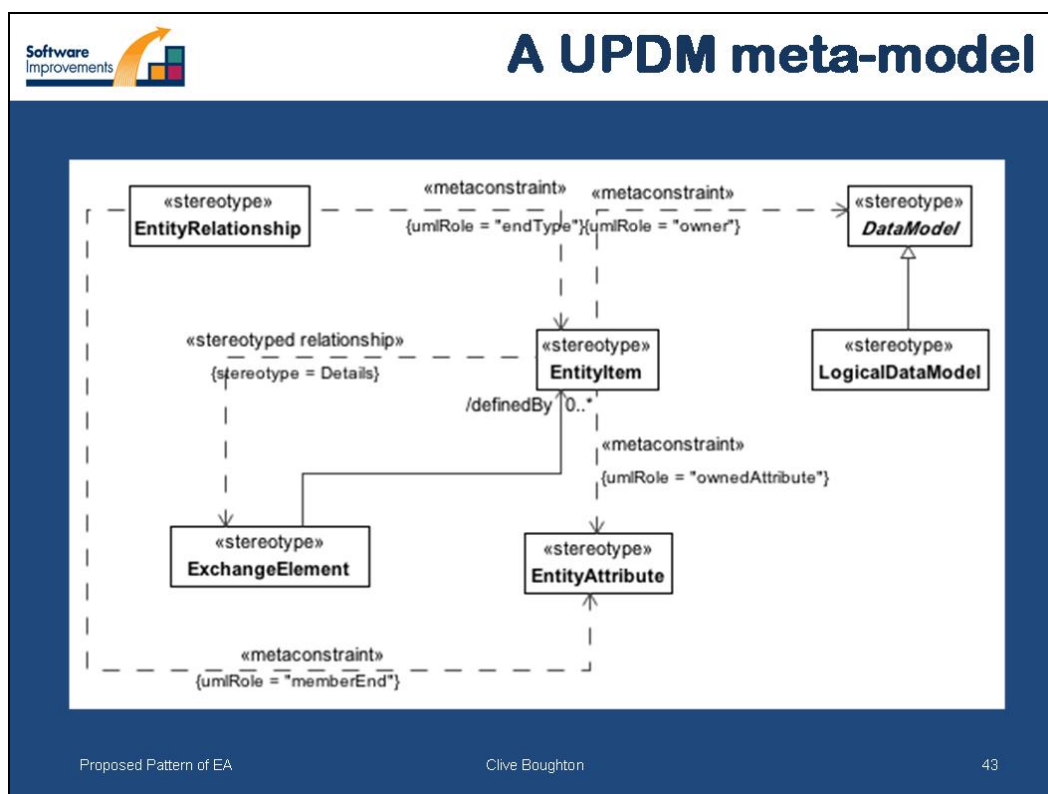
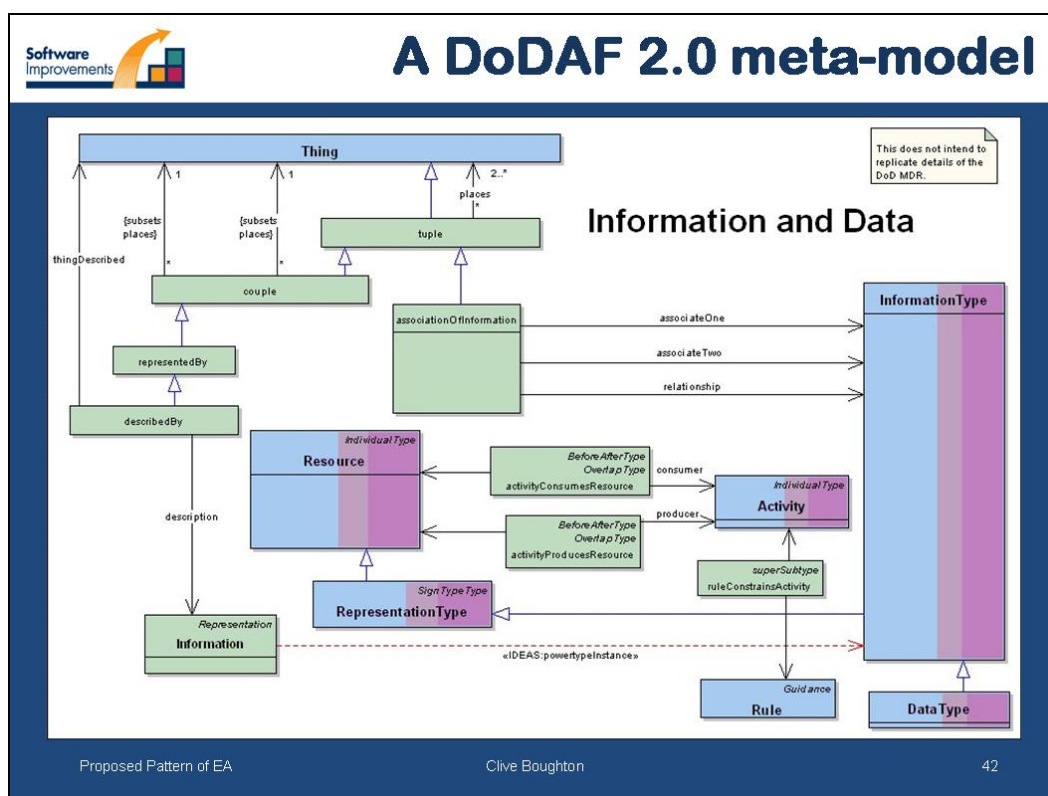



The Pattern



OoKay!
But you mentioned
something about a
pattern.

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Questions



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